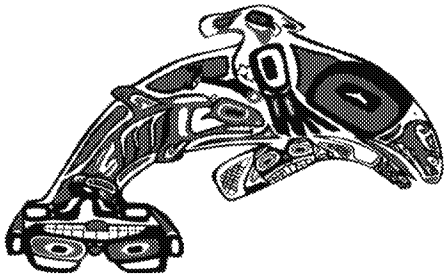

Squaxin Island Tribe

Funding Report

FY 2015 Rights Protection Implementation

Project Title:

Assessment of Climate Related Impacts and Adaptation Planning

Project Leader:

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Climate Change Ecologist
[HYPERLINK "mailto:cpenn@squaxin.us"]
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Bureau of Indian affairs (BIA)
Rights Protection Implementation Climate Change Grant
Assessment of Climate Related Impacts and Adaptation Planning

Introduction and Methods

This is a monitoring report for nutrients, temperature and dissolved oxygen for Oakland Bay under the Rights Protections Implementation Climate change Grant. The Squaxin Island Tribe (SIT) has been monitoring nitrate and nitrite along with other water quality parameters at Johns Creek just upstream of Highway 3 since 2004.

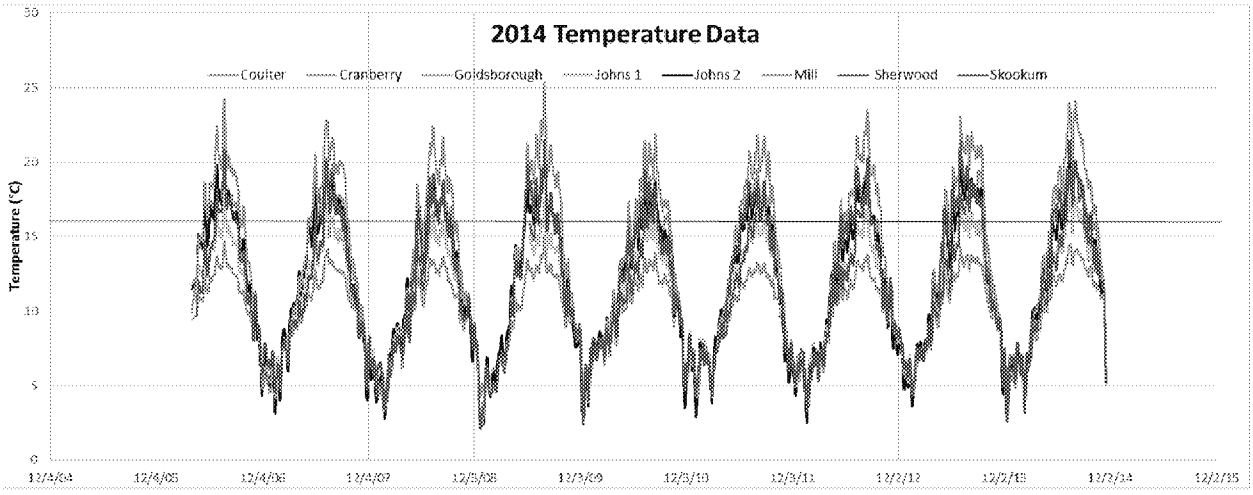
The Tribe has also collected water quality data, excluding nitrogen, from several monitoring locations in streams throughout Oakland Bay for over a decade (Map 1). The highlighted locations on Map 1 indicate individual data collection sites. The list of non-nitrogen water quality parameters includes: pH, fecal coliform bacteria, salinity, specific conductance, turbidity, and total suspended solids. Some of these parameters were continuously measured, others measured as monthly/weekly grab samples, while others were spot checks with field sensors. Data for individual streams is presented in figures 2-7.

Results 2014 Dissolved Oxygen and Temperature

Salmon require cool, well-oxygenated water to survive. The maximum temperature that salmon can tolerate varies with species, life stage, prior acclimation, oxygen availability, duration of warmer temperature, and the presence of pollutants. Juvenile and adult salmon will occupy water that is 13-18°C, with the warmer water selected only if excess food is available. Water temperatures of approximately 23-25°C are lethal to salmon and steelhead, and genetic abnormalities or mortality of salmonid eggs can occur above 11°C. Additionally, the higher the water temperature the lower the amount of oxygen that can be dissolved. This negatively effects over summering salmon.

Figures 1.1 and 2 to 4 show systems in the Oakland Bay watershed that exceed standard temperatures that support healthy salmon populations in 2014. As an example, Figure 1.1 shows that Mill Creek had 64 occurrences in which the 7-day mean of daily maximum value exceeded the temperature criterion for this waterbody.

*Figure [SEQ Figure * ARABIC].1*



Dissolved Oxygen and Temperature Results 2015

Figures 5 to 7 show dissolved oxygen and temperature data collected from 2015. You can see by comparing the two years it's clear that in 2014 Mill Creek (Figure 2.) had four sample events during mid-June and July where the temperature met or exceeded the criterion to support healthy salmon populations. However, Mill Creek data from 2015 shows only sample events that met and did not exceed the standard criterion.

Dissolved Oxygen is slightly higher in 2015 than it was in 2014. There were only 17 occurrences in 2014 which the Dissolved Oxygen Criterion was below levels to support healthy salmon populations. Figures 2-4 from 2014 all show dissolved oxygen to be at levels that result in slight to moderate impairment of embryo production. Figures 5-7 from 2015 show the levels of dissolved oxygen to be sufficient for salmon populations. Table 1 shows examples of recommended dissolved oxygen standard for salmonid waters.

Table 1. Recommended cold-water species dissolved oxygen criteria for salmonid waters (EPA, 1986b).

Level of impairment to embryo and larvae stages	Water column minimum average concentration	Intragravel minimum average concentration
No production impairment	11.0 mg/L	8.0 mg/L
Slight production impairment	9.0 mg/L	6.0 mg/L
Moderate production impairment	8.0 mg/L	5.0 mg/L
Severe production impairment	7.0 mg/L	4.0 mg/L
Limit to avoid acute mortality	6.0 mg/L	3.0 mg/L

Nitrogren Results

In past research SIT assessed how increased fresh water nutrient inputs may increase ocean acidification in marine waters at a local level. After data analysis and further research we have determined that increased fresh water nutrient loading is contributing to the Salish Seas total nitrogen budget. Fresh water input of nitrogen to the Salish Sea as a whole represents only a small portion of the nitrogen at 12.4%. However, freshwater loading into the marine waters of Oakland Bay represents 82.8% of the total nitrogen budget (Steinberg et al Herrera Environmental Consultants). SIT would like to use future funds to identify how we can reduce marine nitrogen loading into Oakland Bay, we can then address each point source of nutrient input individually and as a whole. This will be part of the larger Squaxin Island Tribe strategy to sustain the salmon and shellfish habitat.

Figure 1.3 below shows nitrogen data collected using our in house Suna V2 nutrient meter within Johns Creek. Some significant challenges that hinderded progress of this project was that the Suna V2 nutrient meter that we used to collect nitrate data needed to undergo maintentance during the time we were intending on collecting predicted peak nitrate levels based off last years spikes in nitrogen regime. The meter was in the *Satlantic Suna* shop undergoing maintence for about 3 and a half months. Based on our results from when we were able to collect data, nitrate concentration was relatively low, but it was higher in Nov. 2015 to Jan. 2016 than it had been in Sept. and Oct. 2015.

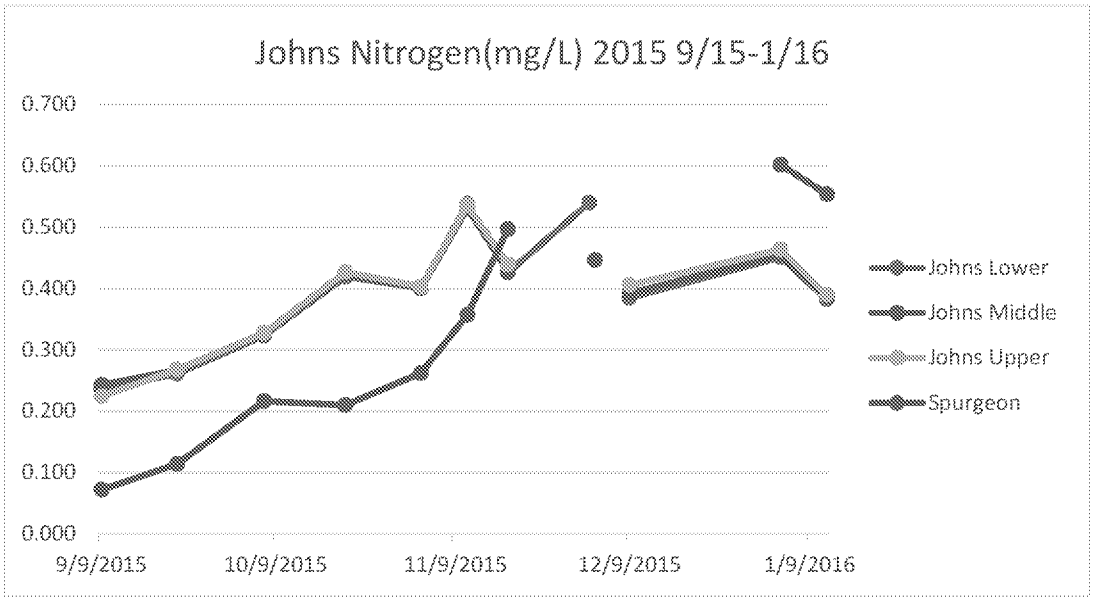


Figure 1.3

Herrera Environmental Consultants:

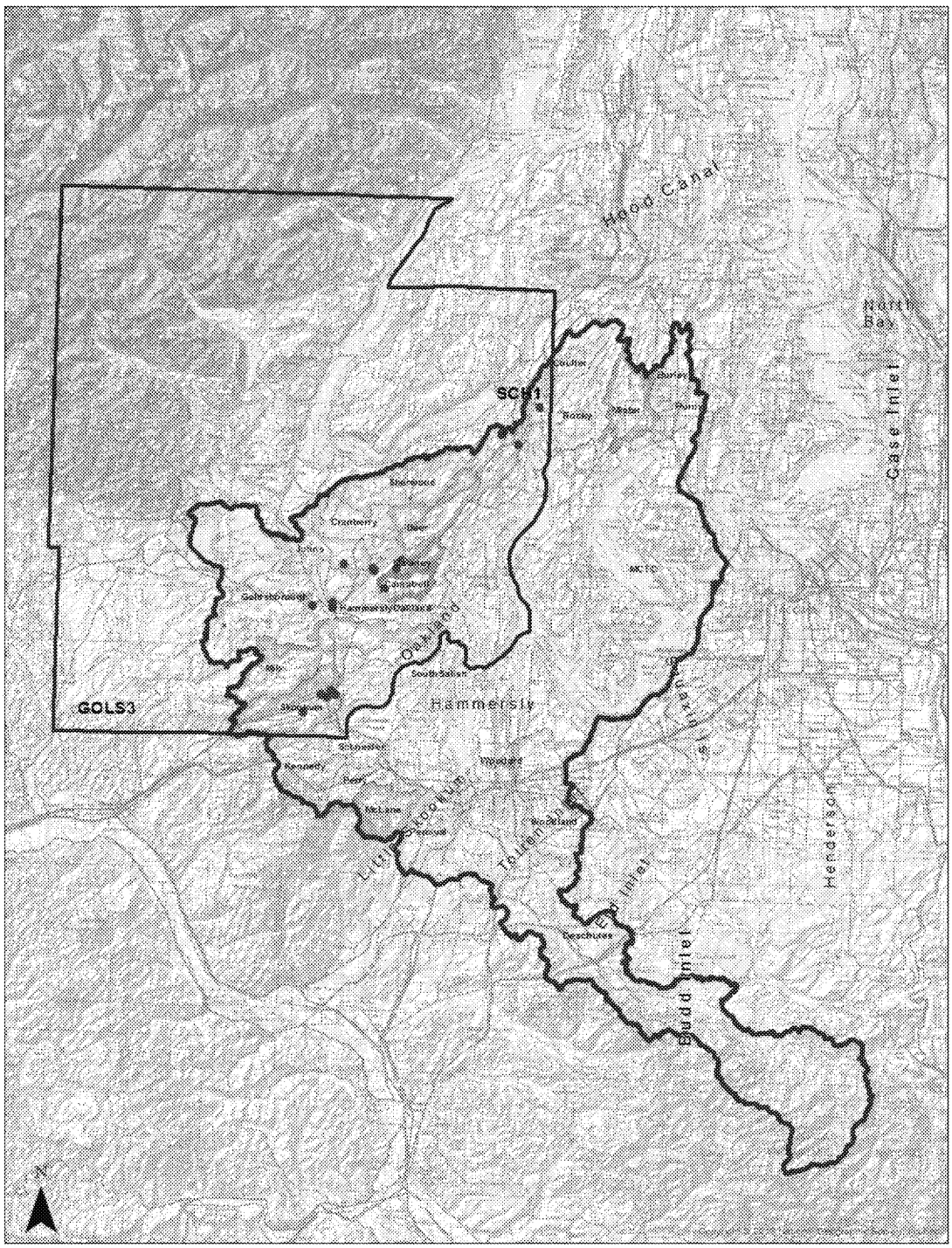
See Appendix 1 (Attached)

Travel and Training

Salish Sea Conference: The Salish Sea Ecosystem Conference is the largest most comprehensive event of its kind in the region. The purpose of the conference is to assemble scientists, First Nations and tribal government representatives, resource managers, community/business leaders, policy makers, educators and students to present the latest scientific research on the state of the ecosystem, and to guide future actions for protecting and restoring the Salish Sea Ecosystem. To accomplish its purpose, the conference will feature plenary sessions with keynote speakers, concurrent sessions featuring oral presentations, poster presentations, workshops, frequent opportunities for informal networking, and related off-program events.

Washington Ocean Acidification Center Science Symposium: Responses in macrozooplankton (J. Keister), Responses in microzooplankton (B. Olson), Responses in crustaceans (P. McElhany), Responses in bivalve species (C. Friedman); Friedmans work was the highlight of the symposium Washington Sea Grant-funded laboratory experiments that examined the responses of five bivalve species (Olympia oyster, Pacific oyster, pinto abalone, geoduck clam, and Manila clam) to combinations of three stresses: dissolved carbon dioxide, elevated water temperature, and exposure to the bacterium Vibrio tubiashii. Researchers also used their work as the basis for a high school biology curriculum on acidification.

Beginner Geographic Information System Class: The Intermediate GIS course built upon the theories discussed in the Introduction to GIS course, and also focused on more of the technical aspects of GIS. The course taught how to operate more advanced functions of the ArcGIS ArcInfo software products for use in mapping and analysis.



Legend

- Mason_County
- Squaxin WQ StationsTo2014
- Squaxin Usual and Accustomed Fishing Area

Squaxin Island Tribe
Water Quality and Quantity Monitoring Stations

Map 1

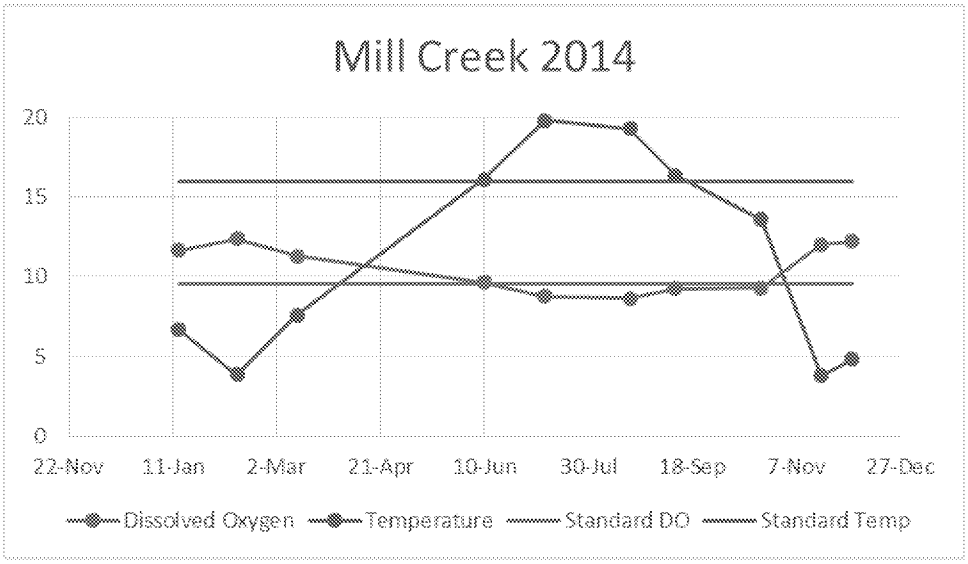


Figure 2.

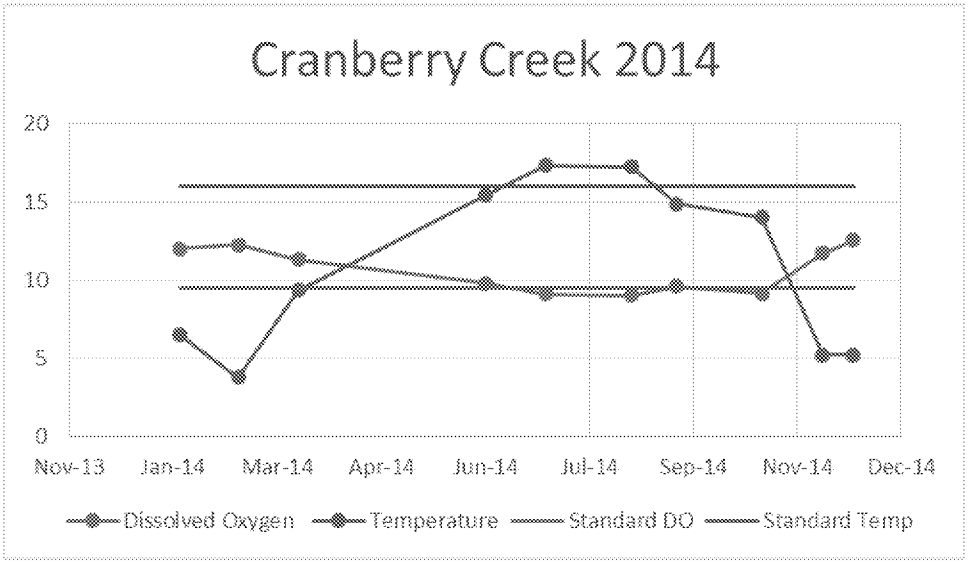


Figure 3.

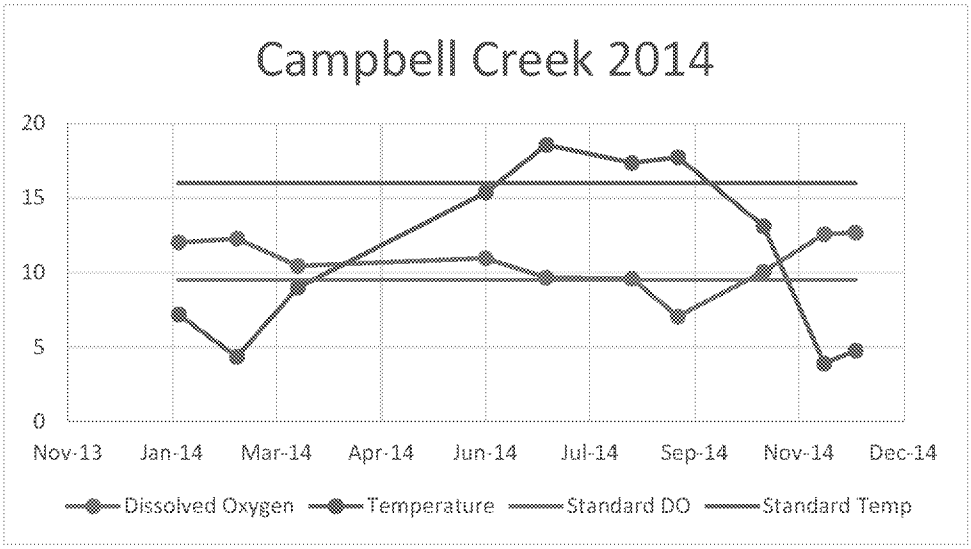


Figure 4.

Figure 5.

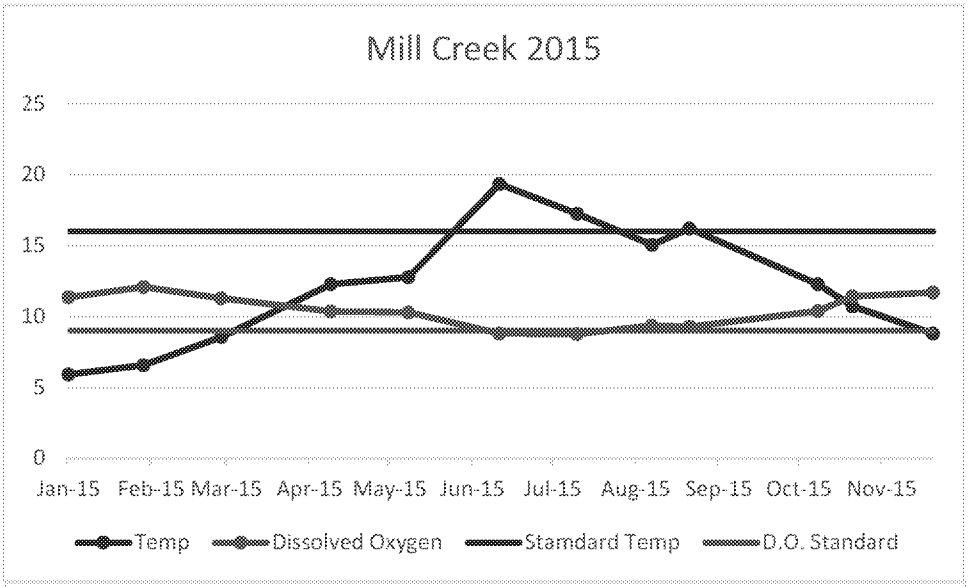


Figure 6.

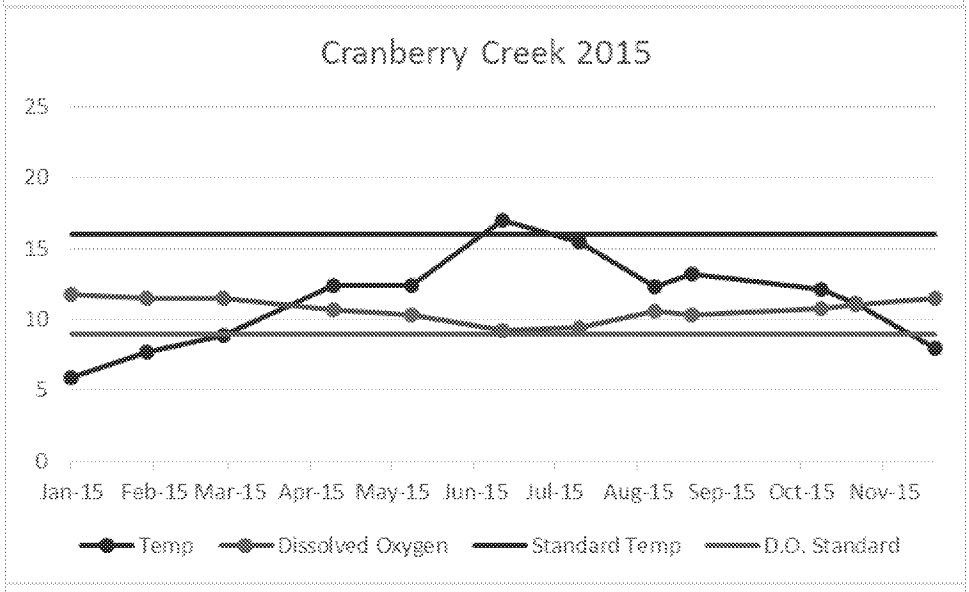
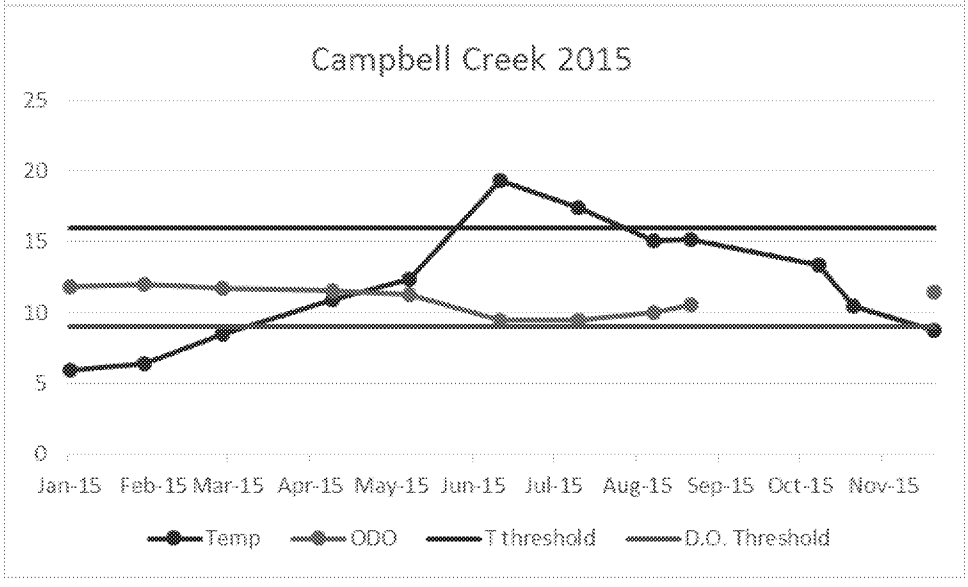


Figure 7.



Discussion

We as The Squaxin Island Tribe are people of the water, since time immemorial. The quality of our water is of highest importance. Under section 303(d) of the Clean Water Act, states, territories and authorized **tribes** are required to submit lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet water quality standards. The law requires that the states establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDL) for these waters. Campbell, Uncle John, Malaney, Shelton, and Goldsborough Creeks – as well as Hammersley Inlet near the mouth of Mill Creek, Upper Oakland Bay, and Inner Shelton Harbor – are listed on the 2004 Washington State 303(d) list. During 2004-2006, the Squaxin Island Tribe and the Washington State Department of Ecology sampled these water bodies. The resulting data was used to develop a total maximum daily load (TMDL) report. Compliance with this TMDL will be based on meeting the water quality standards (Oakland Bay TMDL report). This study and its results compliment and expand upon past studies and are designed to be incorporated into the TMDL.

Conclusion

Water is a precious resource that requires continual care. In 2015, as in years past, Oakland Bay has not met all requirements established by the U.S. Environmental Protection Agency (EPA) and Washington State water quality standards. This report is a snapshot of Oakland Bays' water quality in 2014 and 2015. Included are details about how Oakland Bay compares to EPA standards. Our collected data indicate that tributaries to Oakland Bay have seasonally elevated temperature and lower dissolved oxygen. Dissolved oxygen is slightly higher in 2015 than in 2016. Nitrogen results remain at neutral levels, showing a fall and early winter peak.

Sources

Washington State Dissolved Oxygen Standard a Review and Discussion of Freshwater Intragravel Criteria Development; September 2009 Publication No. 09-03-039

Washington State Department of Ecology, Focus Sheet; Effects of Elevated Water Temperatures on Salmonids

Steinburg et al. Herrera Environmental Consultants "Nitrogen Removal from Oakland Bay and Puget Sound through Shellfish Harvest" Washington Shellfish Environmental and Economic Costs and Benefits (2010)

Oakland Bay, Hammersley Inlet, and Selected Tributaries Fecal Coliform Bacteria Total Maximum Daily Load; Water Quality Improvement Report and Implementation Plan June 2011 Publication No. 11-10-039

Data Disclaimer

The Squaxin Island Tribe provides data "as is." The Squaxin Island Tribe makes no guarantee or warranty concerning the accuracy of information contained in the data. The Squaxin Island Tribe further makes no warranties, either expressed or implied as to any other matter whatsoever, including, without limitation, the condition of the product, or its fitness for any particular purpose. The burden for determining fitness for use lies entirely with the user. Although these data have been processed successfully on computers of the Squaxin Island Tribe, no warranty, expressed or implied, is made by the Squaxin Island Tribe regarding the use of these data on any other system, nor does the fact of distribution constitute or imply any such warranty.

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